The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 34 Number 07 July 2008

Calendar of Events

SUMMER DOWNTOWN OBSERVING

July 09

9:00 PM—10:00 PM

after the Band Concerts

SOUTH PARK

west side of Massachusetts St.

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INSIDE THIS ISSUE

Report from the Officers:

As Rick would say, it looks like the third time was, in fact, the charm. After cancelling our first attempt and getting clouded out during our second, the third post-Band-concert observing session on June 25 went well. The skies were moderately clear and definitely not as humid as most of the last four weeks have been. Thanks to the announcement at the concert and the attraction of the children's concert music, the telescope setup drew a good crowd of a couple of dozen adults and kids interested in viewing the night sky. In addition, we were joined by a Journal-World photographer who snapped a few photos and a pair of students completing a writing assignment for a summer journalism class at KU. The crowd got to view Saturn and Mars through an array of Dobsonions supplied by Rick Heschmeyer, Rex Powell, and William Winkler, as well as two more traditional reflectors of 8-inch and 4-inch size. Even with the help of the KU astronomers and Rick's two sons, everyone was kept relatively busy trying to locate and identify objects as quickly as possible as the twilight sky faded. Fortunately, people were willing to wait patiently and the few that stayed until total darkness got to see some more extended objects like a globular cluster. The next (and final) session in two weeks will be first quarter, so the moon will supply a spectacular view, even if there is a little cirrus.

(Continued on page 2)

Of Local Interest

The status of Pluto and the actions of the IAU regarding Pluto have generated a great deal of controversy among a variety of groups, especially planetary astronomers and Kansans. In their recent press release from mid-June, the IAU has continued its plans to downgrade the planetary status of Pluto by assigning the new class name of Plutoids to the category of dwarf planets. Rather than alleviating the controversy, this decision has rekindled the argument. The IAU press release is repeated in full below. A response to the IAU decision and a call to action from Alan Stern, one of the leading planetary astronomers in the US, can be found on pg. 5

Plutoid chosen as name for Solar System objects like Pluto

The International Astronomical Union has decided on the term plutoid as a name for dwarf planets like Pluto at a meeting of its Executive Committee in Oslo. **A**lmost two years after the International Astronomical Union (IAU) General Assembly introduced the category of dwarf planets, the IAU, as promised, has decided on a name for transneptunian dwarf planets similar to Pluto. The name *plutoid* was proposed by the members of the IAU Committee on Small Body Nomenclature (CSBN), accepted by the Board of Division III, by the IAU Working Group for Planetary System Nomenclature (WGPSN) and approved by the IAU Executive Committee at its recent meeting in Oslo, Norway.

Plutoids are celestial bodies in orbit around the Sun at a semimajor axis

(Continued on page 2)

From the Officers, continued

(Continued from page 1)

One last reminder for July— **ALCON 2008**, the national convention of the Astronomical League, is still scheduled for Des Moines, a city made for walking, on July 18/19. Despite the issues created by the flooding, Des Moines is open! It's business as usual. Community support and collaboration from city and county officials helped prevent major flooding issues throughout downtown Des Moines. Check out http://www.alconexpo.com/ for more info.

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer (rcjbm@sbcglobal.net), the events coordinator for the club. Hope to see you at the final observing session downtown this summer, assuming the weather continues to cooperate. If you are planning on attending but aren't sure if the event is on, after 6PM on the night of the event, we will send email out to all members for whom we have email addresses or you can call the observatory phone line—864-3166—to get the recorded message stating whether the observing is on or has been cancelled. ALL for now.

(Continued from page 1)

greater than that of Neptune that have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium (near-spherical) shape, and that have not cleared the neighbourhood around their orbit. Satellites of plutoids are not plutoids themselves, even if they are massive enough that their shape is dictated by self-gravity. The two known and named *plutoids* are Pluto and Eris. It is expected that more *plutoids* will be named as science progresses and new discoveries are made.

The dwarf planet Ceres is not a *plutoid* as it is located in the asteroid belt between Mars and Jupiter. Current scientific knowledge lends credence to the belief that Ceres is the only object of its kind. Therefore, a separate category of Ceres-like dwarf planets will not be proposed at this time. The IAU has been responsible for naming planetary bodies and their satellites since the early 1900s. The IAU CSBN, who originally proposed the term *plutoid*, is responsible for naming small bodies (except satellites of the major planets) in the Solar System. The CSBN will be working with the IAU WGPSN to determine the names of new *plutoids* to ensure that no dwarf planet shares the name of another small Solar System body. The WGPSN oversees the assignment of names to surface features on bodies in the Solar System. These two committees have previously worked together to accept the names of dwarf planet Eris and its satellite Dysnomia.

In Oslo, members of the IAU also discussed the timing involved with the naming of new *plutoids*. Again, following the advice of the Division III Board and the two Working Groups, it was decided that, for naming purposes, any Solar System body having (a) a semimajor axis greater than that of Neptune, and (b) an absolute magnitude brighter than H = +1 (see Notes) will, for the purpose of naming, be considered to be a *plutoid*, and be named by the WGPSN and the CSBN. Name(s) proposed by the discovery team(s) will be given deference. If further investigations show that the object is not massive enough and does not qualify as a *plutoid*, it will keep its name but change category. In French *plutoid* is *plutoïde*, in Spanish *plutoide* and in Japanese . (FOR MORE, go to pg.5.)

About the Astronomy Associates of Lawrence

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house on Memorial Stadium. Periodic star parties are scheduled as well. For more information, please contact the club officers:Luis Vargas at lcvargas@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu. our events coordinator, Rick Heschmeyer at rcjbm@sbcglobal.net. Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at **http://www.ku.edu/~aal.**

Copies of the *Celestial Mechanic* can also be found on the web at
http://www.ku.edu/~aal/celestialmechanic

White Dwarf Lost in Planetary Nebula

HST Press Release

Call it the case of the missing dwarf.

A team of stellar astronomers is engaged in an interstellar CSI (crime scene investigation). They have two suspects, traces of assault and battery, but no corpse.

The southern planetary nebula SuWt 2 is the scene of the crime, some 6,500 light-years from Earth in the direction of the constellation Centaurus.

SuWt 2 consists of a bright, nearly edge-on glowing ring of gas. Faint lobes extend perpendicularly to the ring, giving the faintest parts of the nebula an hourglass shape.

These glowing ejecta are suspected to have been energized by a star that has now burned out and collapsed to a white dwarf. But the white dwarf is nowhere to be found.

The mystery deepened when researchers obtained ultraviolet observations in the early 1990's with NASA's International Ultraviolet Explorer satellite, expecting to see signs of a faint but very hot star. But no ultraviolet radiation was detected.

Instead, at the center of the nebular ring are two suspicious characters: a pair of tightly bound stars that whirl around each other every five days, neither one of which is a white dwarf. These stars are hotter than our Sun (their spectral class is A) but they are still not hot enough to make the nebula glow. Only a flood of ultraviolet radiation, such as that from the missing white dwarf, could do that.

The study is being conducted by Katrina Exter and Howard Bond of the Space Telescope Science Institute in Baltimore, Md. and a team of British and American colleagues. Their extensive photometry and spectroscopy of the binary show that both stars are larger than main-sequence stars of their masses. This may imply that they have started to evolve toward becoming red giants. Both stars also appear to be rotating more slowly than expected; they would be expected to always be facing the same sides toward each other, but they do not.

The astronomers suggest a simple explanation for the facts at the scene: the stars at the center of SuWt 2 were born as a family of three, with the A stars circling each other tightly and a more massive star orbiting further out. This allowed room for the massive star to evolve to become a red giant, which only then engulfed the pair of A stars. Trapped inside the red giant in what astronomers call a "common envelope," the pair spiraled down toward the core, causing the envelope to spin faster. Eventually, the outer layers of the red giant were ejected in the plane of the orbit, producing the ring-shaped nebula seen today. The unusually slow spins of the two A stars may have been another consequence of their victimization by their massive sibling.

The ground-based observations were obtained with telescopes at the Cerro Tololo Inter- American Observatory, Chile; the New Technology Telescope at the European Southern Observatory, Chile; the Anglo-Australian Telescope, Australia; and the South African Astronomical Observatory.

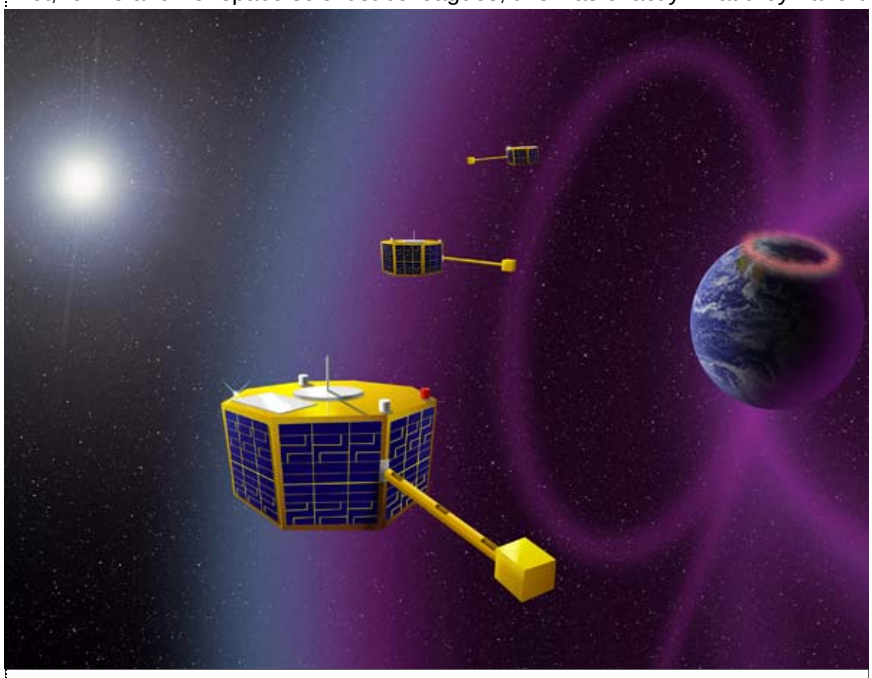
Space Buoys

By Dr. Tony Phillips

Congratulations! You're an oceanographer and you've just received a big grant to investigate the Pacific Ocean. Your task: Map the mighty Pacific's wind and waves, monitor its deep currents, and keep track of continent-sized temperature oscillations that shape weather around the world. Funds are available and you may start immediately.

Oh, there's just one problem: You've got to do this work using no more than *one* ocean buoy. "That would be impossible," says Dr. Guan Le of the Goddard Space Flight Center. "The Pacific's too big to understand by studying just one location."

Yet, for Le and her space scientist colleagues, this was exactly what they have been expected to accomplish in their own studies of Earth's magnetosphere. The magnetosphere is an "ocean" of magnetism and plasma surrounding our planet. Its shores are defined by the outer bounds of Earth's magnetic field and it contains a bewildering mix of matter-energy waves, electrical currents and plasma oscillations spread across a volume billions of times greater than the Pacific Ocean itself.



The Space Technology 5 micro-satellites proved the feasibility of using a constellation of small spacecraft with miniature magnetometers to study Earth's magnetosphere.

"For many years we've struggled to understand the magnetosphere using mostly single spacecraft," says Le. "To really make progress, we need many spacecraft spread through the magnetosphere, working together to understand the whole."

Enter Space Technology 5. In March 2006 NASA launched a trio of experimental satellites to see what three "buoys" could accomplish. Because they weighed only 55 lbs. apiece and measured not much larger than a birthday cake, the three ST5 "micro-satellites" fit onboard a single Pegasus rocket. Above Earth's atmosphere, the three were flung like Frisbees from the rocket's body into the magnetosphere by a revolutionary micro-satellite launcher.

Space Technology 5 is a mission of NASA's New Millennium Program, which tests innovative technologies for use on future space missions. The 90-day flight of ST5 validated several devices crucial to space buoys: miniature magnetometers, high-efficiency solar arrays, and some strange-looking but effective micro-antennas designed from principles of Darwinian evolution. Also, ST5 showed that three satellites could maneuver together as a "constellation," spreading out to measure complex fields and currents.

"ST5 was able to measure the motion and thickness of current sheets in the magnetosphere," says Le, the mission's project scientist at Goddard. "This could not have been done with a single spacecraft, no matter how capable." The ST5 mission is finished but the technology it tested will key future studies of the magnetosphere. Thanks to ST5, hopes Le, lonely buoys will soon be a thing of the past.

Learn more about ST5's miniaturized technologies at nmp.nasa.gov/st5. Kids (and grownups) can get a better understanding of the artificial evolutionary process used to design ST5's antennas at spaceplace.nasa.gov/en/kids/st5/emoticon. *This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.*

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Dwarf Planets Are Planets Too: Get Involved!

by Alan Stern

Classification is an important and productive scientific tool that is employed in many branches of science, from biology to geology to chemistry and astronomy.

Planetary science today faces a significant classification challenge: defining what objects are and are not "planets." This challenge has come to the fore owing to the discovery of numerous dwarf planets in the outer solar system, the recognition that Ceres is a dwarf planet (a fundamentally different body than the smaller asteroids), the discovery of planets around a pulsar, and the numerous discoveries of hot Jupiters orbiting other stars.

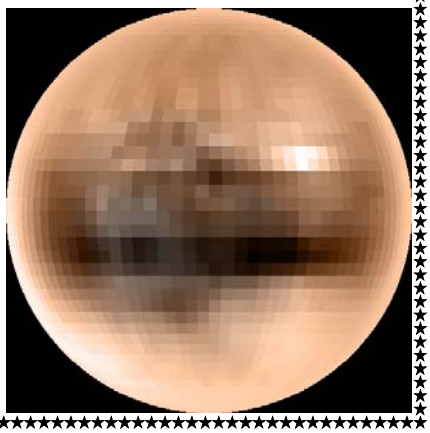
Geophysicists have come up with a planetary definition that makes a lot of sense. They define a "planet" as a natural object in space that is massive enough for gravity to make it approximately spherical, but not so massive that it has generated energy by internal nuclear fusion. This definition nicely separates planets (i.e., objects larger than a few hundred kilometers across) from both smaller bodies that are too small to be fundamentally shaped by gravity, and larger bodies (very many times the mass of Jupiter) that manifest themselves as brown dwarfs and stars.

Scientists and the public would be much better off if we adopted a comprehensive planetary definition that is a self-consistent and allows astronomers to reliably and consistently sort objects into "planetary" and other categories. The geophysical definition does just that because it allows scientists to reliably categorize bodies based on a single, simple, robust observable property—their known or estimated mass.

The geophysical planetary definition avoids the severe difficulties associated with other concepts. Some definitions depend on how objects affect their orbital zones. But these definitions result in identical objects being classified differently depending on their circumstance. Earth, for example, would not be considered a planet if it orbited the Sun beyond Neptune, because its gravitational influence would be insufficient to clear out the Kuiper Belt. Definitions based on origin are problematic because we can rarely determine how an object formed, especially if it's outside the solar system. Definitions based on the presence of an atmosphere or satellites are also problematic, since they can be exceedingly difficult to determine observationally, and each of these factors would rule out various objects commonly regarded as textbook examples of planets in our solar system.

The geophysical planetary definition does not tilt the population of planets in a system based on scientific biases such as preference for a limited number of planets in our solar system. Instead, it embraces the diversity of planetary types being discovered in our solar system and around other stars.

Unfortunately, the International Astronomical Union (IAU), populated primarily by astronomers who do not even study planets, has resisted the geophysical planetary definition that is popular among planetary scientists. The IAU's president has recently said that few scientists or laypeople are unhappy with the IAU's planetary definition, which excludes dwarf planets. But this statement is false. Public polls like the one at http://plutopetition.com/produced many tens of thousands of votes, slanted heavily in favor of dwarf planets being full-fledged planets. Further, more planetary scientists pledged not to use the IAU's definition (http://www.ipetitions.com/petition/planetprotest/) than were even in the IAU meeting room in Prague when the IAU voted on this matter.



If you are interested in this subject, consider attending the **GREAT PLANET DEBATE** this August in Maryland (For more details on this, go to http://gpd.jhuapl.edu/). You can also voice your opinion at http://www.nasawatch.com/archives/2008/06/iau_snobbery.html.

You can also contact the IAU directly at iau@iap.fr.

Galaxy Zoo's blue mystery
By Janet Raloff, Science News

Nearly a year ago, astronomers at several universities recruited citizen scientists to help them catalog distant galaxies that had recently been photographed as part of the Sloan Digital Sky Survey. A high-school physics teacher in the Netherlands who was participating in this project, known as Galaxy Zoo, appears to have scored a major coup. She brought a weird blue object to the attention of the professional zookeepers, according to a cosmologist associated with the zoo.

That novelty appears to be a quasar whose intense radio emissions have been fueling star births. Alex Szalay of Johns Hopkins University, and a project director for the National Virtual Observatory, was today's keynote speaker, here in Pittsburgh, at the Joint Conference on Digital Libraries. He reflected on how much data had been collected during the Sloan survey, which wrapped up a month ago. Its organizers expected this project, designed to be the most comprehensive photographic imaging of the northern skies, to take some five years. It actually took 16. In the process, it collected more data than astronomers decided they could ever realistically review and catalog. So they released more than a million never-before-seen images for the public to peruse in the comfort of their own homes. After a bit of online training, each was asked to categorize the type or shape of galaxies in any image they viewed.

"We expected to get several hundred people a day" taking part, Szalay says. In fact, the first day alone there were several million. During the past 11 months, the public has turned in some 40 million galaxy classifications. But the one that has astronomers scratching their heads is the Dutch report of a weird blue object, or *Voorwerp*. A teacher named Hanny reported the mystery cloud on a Galaxy Zoo blog in mid-August and asked if anyone knew what it might be.

Her request didn't really catch the eye of scientists until around Christmas, Szalay says. Since then, astronomers have been abuzz over the enigmatic object. They've also been filing requests to get viewing time on major telescopes in coming months for a better look. What initially slowed an evaluation of Hanny's *Voorwerp* was that "we didn't have a spectrum for it, so it could have been literally anywhere from right next door in our galaxy to the edge of the universe," explained Kevin, another Galaxy Zoo blogger, on Jan. 31. A helpful colleague, astronomer Bill Keel of the University of Alabama, performed that spectral analysis and shared it as a guest GZ blogger. He described the novelty as "a deep blue, irregular cloud, just south of the spiral galaxy IC 2497."

Piecing together odd bits about that galaxy, the newfound object's spectra, and some additional crisp imaging of the region, Keel concluded: "The *Voorwerp* is at almost exactly the same redshift [or distance] as IC 2497, and almost certainly associated with it." The object's intense and narrow range of blue emissions, he said, "are what one would see from a star-forming region. But there are some things about it that are strange, and need more work." Moreover, he added, "Whatever this is, it's rare." Galaxy zookeeper Chris Lintott of Oxford University in England scanned for other blue objects in the survey database. Keel said Lintott found none emitting colors close to "what we see here."

Szalay says Lintott has now formally drafted a proposal to use the Space Telescope, together with Keel to study the *Voorwerp.* "And we just got a notification, about a week ago," Szalay told me, "that we're getting seven orbits [to do this], which will be scheduled at some time in the fall."

Szalay says other preliminary observations with an ultraviolet satellite have been completed, and Keel has asked to use the Very Large Array radio telescope near Socorro, N.M., for additional glances at this strange celestial object.

Currently, no one is sure what the wispy blue cloud is. But Szalay says it appears to be "radiation emitted by a quasar." Only one similar object is known, he says: Minkowski's object.

I'd never heard of it before. But googling the name turned up descriptions suggesting Minkowski's *Voorwerp* is a stellar nursery — incubating some 10 million stars. This conglomeration is thought to have formed when a jet of intense radio waves slammed into a patch of dense gas. The source of the radio jet: a black hole at the core of a nearby galaxy (NGC 541).

It's not yet known whether the new *Voorwerp* is the same thing, "but it has similarities," Szalay says. Whatever it turns out to be, he says the enterprise that uncovered it "blew my mind. You read in the papers that today people are not interested in science." But the number of GZ recruits, or zooties, confirm that much of the public is not only interested in science, he says, but willing to take part in it.

"This is different from running something on your computer, like SETI@home or the prime-number search," he maintains. GZ requires that nonscientists actually use their brain power. Not only can this armchair astronomy be fun, he says, but participants "can make a genuine discovery" — as Hanny did.

Astronomy Associates of Lawrence

2008 DATES

July 9

Time: 9:00 PM—10:00 PM

Astronomy in the Park*

Join the

Astronomy Associates of Lawrence

in South Park as they share views of the night sky through a variety of telescopes.

It's free!

Online: **http://groups.ku.edu/~astronomy**

Telescopes will be set up in South Park on the WEST side of Massachusetts Street after the City Band concerts on the dates listed above.

Astronomy Associates of Lawrence

C/O KU Physics and Astronomy Dept.

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**** WEATHER PERMITTING***

Twinkle Little Star, How Prolific You Are: 3 Super-Earths Circle Star Once Thought Barren
By SETH BORENSTEIN, AP Science Writer

European astronomers have found a trio of "super-Earths" closely circling a star that astronomers once figured had nothing orbiting it. The discovery demonstrates that planets keep popping up in unexpected places around the universe. Monday's announcement is the first time three planets close to Earth's size were found orbiting a single star, said Swiss astronomer Didier Queloz. He was part of the Swiss-French team using the European Southern Observatory's La Silla Observatory in the desert in Chile.

The mass of the smallest of the super-Earths is about four times the size of Earth. That may seem like a lot, but they are quite a bit closer in size and likely composition to Earth than the giants in Earth's solar system _ Jupiter, Saturn, Uranus and Neptune. They are much too hot to support life, Queloz said.

Scientists are more interested in the broader implications of the finding: The universe is teeming with far more planets than thought. Using a new tool to study more than 100 stars once thought to be devoid of planets, the Swiss-French team found that about one-third had planets that are only slightly bigger than Earth.

That's how the star with three super-Earths, 42 light-years away, was spotted. The European team took a second look with a relatively new instrument that measures tiny changes in light wave lengths and is so sensitive that it is precisely positioned and locked in a special room below the observatory in Chile. The key is kept in Switzerland, scientists say.

The discovery is "really making the case that we live in a crowded universe," said Carnegie Institution of Washington astronomer Alan Boss, who was not part of the discovery team. "Planets are out there. They're all over the place." That means it is easier to make the case for life elsewhere in the universe, both Boss and Queloz said.

Safe from Black Holes
by Ron Cowen, Science News

Any black holes created at a new particle accelerator near Geneva will not make Swiss cheese of the nearby countryside. Nor will they gobble up Earth. That's the consensus of two new reports, including a safety review released June 20 by the European Organization for Nuclear Research, or CERN, the group that oversees the Large Hadron Collider.

Scheduled to start this September, the collider will be the most powerful particle accelerator in the world. Protons in the accelerator will reach energies of 7 trillion electron volts and smash into each other at nearly the speed of light, briefly re-creating the extreme densities and energies existing a tiny fraction of a second after the Big Bang. Some people, including a group based in Hawaii that has filed a lawsuit against CERN, worry that those collisions could somehow generate stable black holes that might swallow the planet.

In fact, it is possible that the LHC, according to one theory, could be a veritable factory of mini-black holes — no larger than a thousandth of the diameter of a proton. That theory proposes that gravity is weak, compared to the other forces in nature, because some of it leaks out into other, hidden dimensions folded up into sizes as small as 10^{-17} centimeters, a tiny fraction of the diameter of a hydrogen atom. At the high energies and small scales probed by the LHC, gravity would become much stronger than it is in ordinary three-dimensional space. Gravity could then cram enough matter together to form microscopic black holes as often as once a second.

However, such black holes, according to research first reported by Stephen Hawking in the 1970s, ought to rapidly radiate away their energy and evaporate in an instant, before doing any harm. But even if Hawking is wrong, and tiny black holes linger, they still would not pose a danger, according to the new studies. Study member John Ellis of CERN noted that the CERN safety report was independently reviewed by a group of 20 scientists outside CERN, including Nobel laureate Gerard 't Hooft, an expert on black hole theory. The report also relies on a separate study, by Steve Giddings of the University of California, Santa Barbara and Michelangelo Mangano of CERN, set to appear in an upcoming *Physical Review D*. Both studies reaffirm the findings of a 2003 CERN report that the high-energy collisions generated at the LHC would pose no danger to Earth.

The studies note that cosmic rays — charged particles from outer space that have energies far greater than those generated at the LHC — have pummeled Earth for billions of years. These collisions could have generated as many black holes as a million LHC experiments, yet the planet still exists. Cosmic rays also bombard dense stars — white dwarfs and neutron stars — yet those bodies endure despite the fact that any encounter with a black hole would consume these objects much more rapidly than they would Earth, notes Ellis.

The possibility of even creating tiny black holes at the LHC is "quite a long shot," notes Giddings. But he's hoping that long shot comes through. "Not only would we learn things about gravity and the fabric of space-time, but we would apparently have direct evidence for extra dimensions of space," Giddings says. It might also serve to unify gravity with the other forces in nature.

Far From Identical

Vanderbilt University Press Release

The analysis of the youngest pair of identical twin stars yet discovered has revealed surprising differences in brightness, surface temperature and possibly even the size of the two.

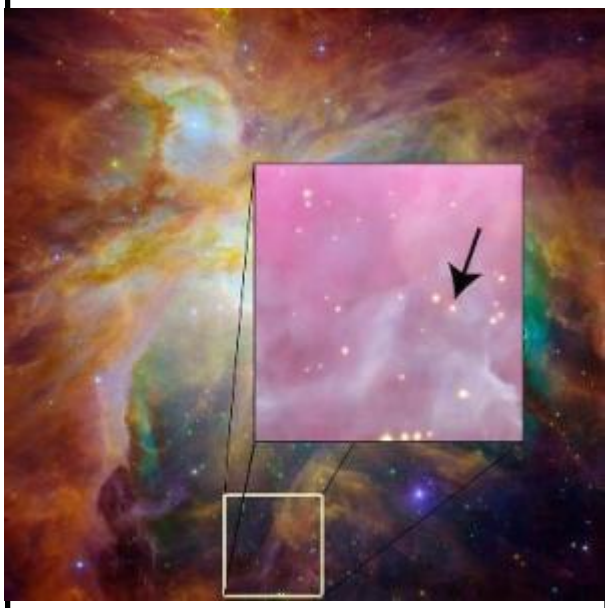
The study, which is published in the June 19 issue of the journal Nature, suggests that one of the stars formed significantly earlier than its twin. Because astrophysicists have assumed that binary stars form simultaneously, the discovery provides an important new test for successful star formation theories, forcing theorists back to the drawing board to determine if their models can produce binaries with stars that form at different times.

The identical twins were discovered in the Orion Nebula, a well-known stellar nursery, that is 1,500 light years away. The newly formed stars are about one million years old. With a full lifespan of about 50 billion years, that makes them equivalent to one-day-old human babies.

“Very young eclipsing binaries like this are the Rosetta stones that tell us about the life history of newly formed stars,” says Keivan Stassun, associate professor of astronomy at Vanderbilt University. He and Robert D. Mathieu from the University of Wisconsin-Madison headed up the project.

Eclipsing binaries are pairs of stars that revolve around an axis at a right angle to the direction to Earth. This orientation allows astronomers to determine the rate that the two stars orbit around each other – even when they cannot resolve the individual stars – by measuring the periodic variations in brightness that result when the stars pass in front of each other. With this information, astronomers can determine the masses of the two stars using Newton’s laws of motion.

In this fashion, the astronomers calculate that the newly discovered twins have nearly identical masses 41 percent that of the sun. According to current theories, mass and composition are the two factors that determine a star’s physical characteristics and dictate its entire life cycle. Because the two stars condensed from the same cloud of gas and dust they should have the same composition. With identical mass and composition, they should be identical in every way. So the astronomers were surprised when they discovered that the twins exhibited significant differences in brightness, surface temperature and possibly size.



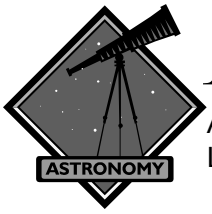
The arrow points to the location of the identical twin stars in the Orion Nebula, the stellar nursery that is closest to Earth. The pair are in such a close orbit that they appear as a single point of light. (Credit: NASA/ JPL, HST, David James)

The astronomers made the initial measurements of the eclipses of the two stars by sifting through nearly 15 years’ worth of observations of several thousand stars using a telescope at the Kitt Peak National Observatory in Arizona and the SMARTS telescopes at the Cerro Tololo Inter-American Observatory in Chile. In order to gain more information about the two stars, they made additional measurements using the Hobby Eberly Telescope in Texas.

By measuring the difference in the amount that the light dipped during the eclipses, the astronomers were able to determine that one of the stars is two times brighter than the other and calculate that the brighter star has a surface temperature about 300 degrees higher than its twin. An additional analysis of the light spectrum coming from the pair also suggests that one of the stars is about 10 percent larger than the other, but additional observations are needed to confirm it.

“The easiest way to explain these differences is if one star was formed about 500,000 years before its twin,” says Stassun. “That is equivalent to a human birth-order difference of about half of a day.”

In addition to causing theorists to re-examine star-formation models, the new discovery may cause astronomers to readjust their estimates of the masses and ages of thousands of young stars less than a few million years old. Current estimates are based on models that were calibrated with measurements of young binary stars that were presumed to have formed simultaneously. The recalibration required could be as much as 20 percent for the mass of a typical young star and as much as 50 percent for very low-mass stars like brown dwarfs, Stassun estimates.



AAL

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